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This is the fourth issue of the *Research Supplement* to *The Magic Lantern Gazette*, a publication intended to present serious scholarly research, including lengthy articles that may not fit into a standard academic journal format. This issue contains one of my own articles. The research for this piece was largely completed several years ago, but writing and production was delayed by a long, tedious list of medical issues. I decided I probably should get it done now.

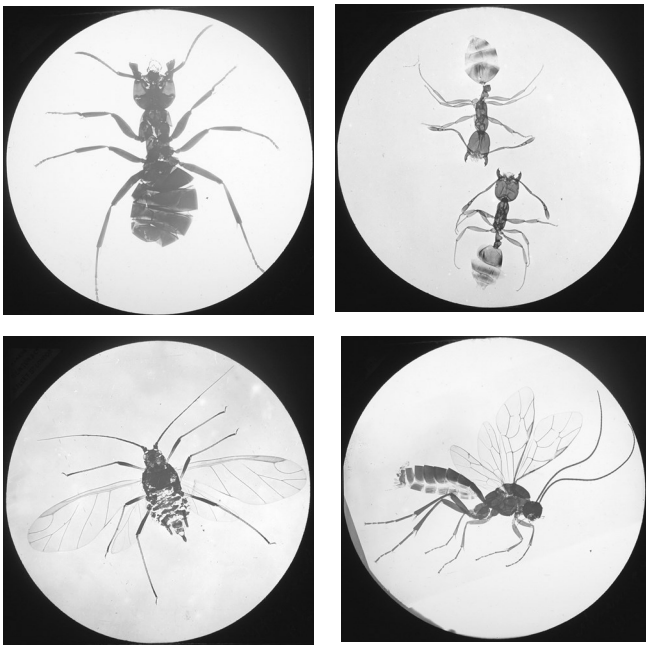
As a professional biologist with an interest in natural history going back into childhood, with an additional strong interest in the history of science, I have wondered how popular illustrated lectures on biology and natural history fit into the overall lantern lecture culture of 19 Century America. Recently a number of studies of popular illustrated lectures on science have appeared, dealing mostly with Western Europe; almost nothing has been published on North America.

Science, especially the biological sciences, played a minor role in America popular lecture culture until the 1880s. All sorts of factors were responsible for this lack of interest in the subject. One is the nearly complete absence of formal education in biology at the high school and college level. Even in the last decades of the 19th Century, only a tiny fraction of the population attended high school, and high school biology as a unified part of the curriculum did not exist. This carried over to the even smaller group of men who sought advanced training in biology (women were largely excluded). Some did higher university degrees in Germany or took an assortment of biology-related course while studying for a degree in another subject, or completed degrees in medicine. Employment opportunities were even scarcer, Individuals interested in biology found themselves teaching a wide range of subjects from biology, chemistry, physics, English literature, American history, foreign languages, music, and art.

Finally, there was the issue of how to illustrate science lectures for popular audiences, which often required more sophisticated and complex visual aids than lectures on art, travel, and similar topics that filled the illustrated lecture circuit in the late 19th Century and well into the 20th Century. My article provides a brief introduction to the various alternatives to magic lantern slides as illustrative aids for biology lectures.

One thing that became clear in the course of writing this article is that the use of newspaper advertisement surveys, which I have used successfully to trace the careers of traveling lecturers such as George Cromwell, fails to capture more than a small fraction of the lecturers presenting serious lectures on science. For the most part, scientists did not embark on cross country lecture tours. Increasingly, venues for popular biology lectures shifted from YMCA halls, churches, town halls, and similar public spaces to more specialized audiences that could be found in botanical clubs and gardens, natural history clubs, institutes, colleges, universities, and natural history museums. Popular lectures often were presented as a series of lectures by one or more experts, with only one mention finding its way into a newspaper. Clearly more in depth research in publications and archives of these institutions is needed to fill out the complete pictutre of public lectures on biology and natural history.

Kentwood D. Wells, Editor
kentwood.wells @uconn.edu



Magic lantern slides of ants and other insects. Wells collection.

Illustrated Popular Lectures on Biology and Natural History in 19th Century America

Kentwood D. Wells
451 Middle Turnpike
Storrs CT 06268
kentwood.wells@uconn.edu

Throughout the 19th century, itinerant and institutional lecturers included scientific subjects in their lectures, illustrated with magic lantern slides or other visual aids. Scientific topics probably never accounted for more than a small fraction of all popular lectures, and within the sciences, biology was never the most popular topic. That distinction belongs to astronomy, which became a popular subject for public lectures early in the century and never lost its appeal, even as lecturers gradually switched from mechanical models of the solar system (orreries) to colorful lantern slides to illustrate movements of celestial bodies.[1] A search of 19th century American newspaper databases reveals few examples of illustrated lectures on biology before 1870. An exception is the use of the oxyhydrogen microscope, introduced into the United States in the 1820s, to project enormously enlarged images of living and dead insects, fly eyes, and other microscopic objects. However, in most cases, these were not serious scientific lectures, but entertainment shows that emphasized the optical wonders of the instrument, not the biology of the organisms projected on the screen.[2]

One reason for the scarcity of public lectures on biological topics is the lack of experts with sufficient knowledge of the subject to prepare an informative lecture. The development of a clearly defined academic field of biology in the United States lagged well behind progress in Europe, and most of the key breakthroughs in biological research, such as the Cell Theory, Darwin's Theory of Evolution, or the Germ Theory of Disease, were achieved by European scientists. By the 1850s, courses that covered various fields of biology were available in elite colleges such as Harvard, Yale, and Amherst, but mostly as optional courses rather than part of a unified biology curriculum. Some colleges viewed courses in natural history or biology as suitable for students who were not prepared for prestigious careers in law or medicine. Advanced training in biology simply did not exist. The first Ph.D. degree in any scientific field was awarded by Yale in 1861, but it was only after 1870 that universities began awarding advanced degrees in biology. Even then, courses of study usually were divided into fields such as botany, zoology, or physiology, with students in one field having little exposure to courses in other fields.[3]

For men who aspired to become naturalists (and they almost all were men), many obtained a year or more of training in medicine, which allowed them to make a modest income while becoming largely self-taught in a field of natural history such as botany. Some of these individuals eventually gave illustrated public lectures or taught a variety of science courses in schools and colleges. Asa Gray (1810-1888), who became one of America's leading botanists, grew up in upstate New York and chose to study medicine instead of enrolling in a traditional college. By age 21, he was a practicing physician while supplementing his income by teach courses in botany, chemistry, physics, and mineralogy. He became an expert botanist, largely through personal interactions with a number of established botanists, and eventually was appointed Professor of Botany at Harvard and became one of Darwin's main American supporters. Unfortunately, as we shall see, his attempts at public lecturing were short-lived.[4]

Another problem was the very low level of education in natural sciences available to most 19th century Americans. As late as 1900, only 4% of the population attended secondary school. In some schools, students could take elective courses in the various components of biology, including botany, zoology, and physiology, but there was no integrated biology curriculum. As historian of science Philip M. Pauley put it, "Before 1900, there was no such experience as high school biology."[5] Writing in 1883, Minnesota teacher A. F. Bechdolt decried the lack of natural science in American public schools, arguing that science was an important part of American culture that deserved more attention in the schools:

> Twenty-five years ago a lecture on a scientific subject most likely meant a talk on astronomy with magic lantern views of the planets: today it would mean a lecture on the evolution of species, or some question connected with it, and the illustrations would be stereopticon views of the monsters of geologic time **(see front cover)**. It was then not unusual in our higher institutions of learning for the professor of mathematics to have charge of the instruction in physics and astronomy, and in some, a little more conservative, of biology and chemistry as well.[6]

Bechdolt argued that science education based on observation of nature and experimentation was best suited to the needs of modern American society.[7]

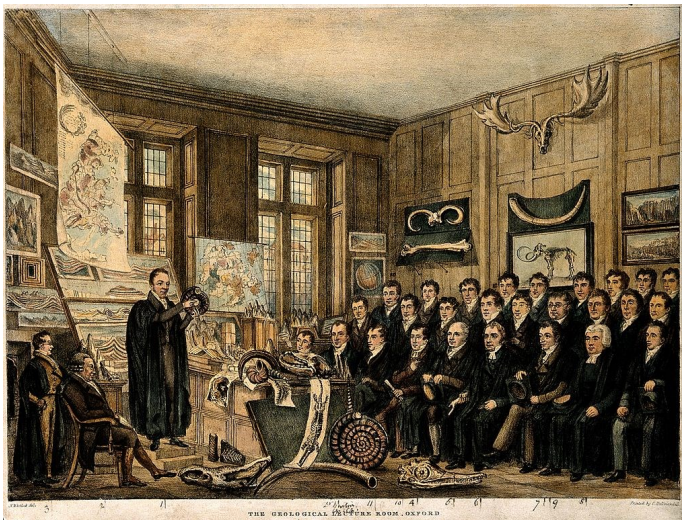


Fig. 1. British paleontologist William Buckland lecturing to a group of scientific gentlemen in 1823, using a combination of fossil specimens and specially prepared wall charts to illustrate his points. These types of visual aids were suitable for a relatively small audience. Wellcome Collection.

Illustrating Biology and Natural History

Many public lectures were not illustrated, with the lecturer relying on the power of his voice to paint a word picture for the audience. Many science lecturers, however, found various kinds to visual aids to be essential for explaining their material.[8] William Buckland (1784-1856) was famous for his colorful lectures featuring fossils of exotic ancient creatures (Fig. 1). He was the first contributor to a series of books, the *Bridgewater Treatises*, published in the 1830s, which attempted to reconcile the facts of science with religion. Buckland spent a lot of money having illustrations prepared for his book, which took up a whole second volume of the treatise.[9] He later spent large sums having some of these illustrations enlarged to wall poster size to illustrate his lectures. Many of these illustrations have been preserved in the Oxford Museum and have clusters of tiny holes in the upper corners, indicating that they were tacked to a wall or board for use in a lecture.[10]

In the first half of the 19th century, some lecturers illustrated their lectures with large drawings or oil paintings, which would have been visible to larger audiences, but were awkward to handle. No doubt lecturers took advantage of public enthusiasm for painted panoramas, which were being exhibited throughout the country.[11] When botanist Asa Gray (Fig. 2) was invited to deliver a series of lectures to the prestigious Lowell Institute in 1844, he worried about finding someone to prepare illustrations, eventually hiring Susan Quincy, the daughter of Harvard's president, to make botanical drawings, which eventually became a set of large paintings six to eight feet high. Gray proved not to be a very good lecturer and soon gave up public lecturing altogether.[12]

Fig. 2. Asa Gray, American botanist, who used large paintings to illustrate his public lectures before the Lowell Institute. From a daguerreotype taken in 1841.

In 1842, British geologist Charles Lyell was travelling and lecturing across the United States. He delivered a series of 12 lectures in Philadelphia. His lecture on Niagara Falls was illustrated by a large and colorful bird's eye view painting of the falls and the surrounding area. This was prepared by a local theater scene painter, Russell Smith (1812-1896), who later had a successful career as a landscape painter, especially in the White Mountains of New Hampshire, and as a draftsman making illustrations for scientific lectures and drawings for geological surveys.[13]

When Swiss naturalist Louis Agassiz arrived in the United States in the 1840s, he was invited to give a series of lectures on the Alps and glaciers. These lectures were illustrated with a large panoramic painting of the Swiss Alps, maps, diagrams, and blackboard drawings. According to his biographer, when Agassiz returned to the Lowell Institute in 1865 to give a series of lectures on the same subject, "He topped his earlier performance by using a stereopticon." In fact, the lantern slides were used more to introduce the lectures than to illustrate them. They were presented by Prof. Josiah Cooke (1827-1894) in the initial lecture in the series and probably belonged to Cooke. Cooke was a chemist and fellow Harvard faculty member who designed his own vertical carbon-arc electric lantern in the 1850s to illustrate his own lectures; this lantern became the model for the College Lantern later developed by Henry Morton. Agassiz was never well known for illustrating his lectures with lantern slides, especially those on natural history and zoology, which were mostly illustrated with blackboard drawings (Fig. 3).[14]

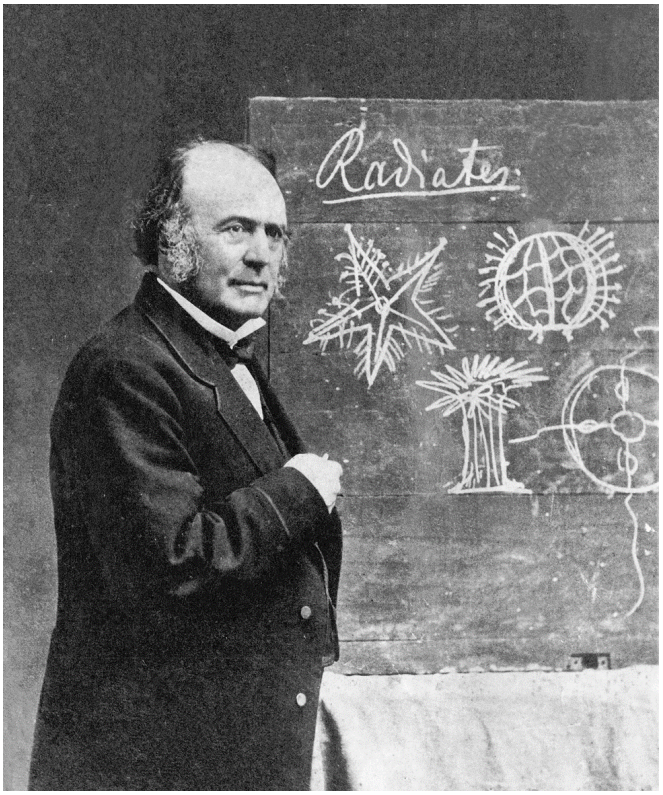


Fig. 3. Louis Agassiz was famous for using blackboard drawings of animals to illustrate his lectures on natural history and entertain his audiences. Wikimedia

Other visiting lecturers from Europe adopted the practice of using freehand drawings in their lectures. For example, the renowned British biologist and defender of Darwin, Thomas Huxley (Fig. 4), was well known for his blackboard drawings of comparative anatomy and zoology.[15]

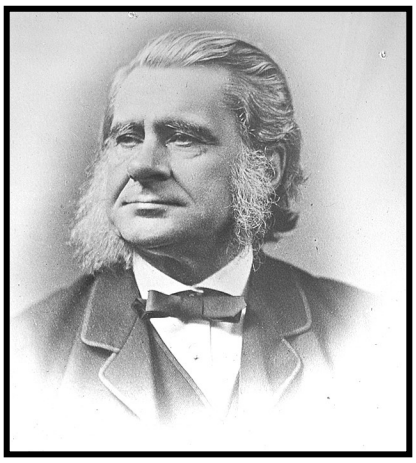


Fig. 4. Lantern slide of Thomas Henry Huxley. Wells collection.

British natural history illustrator and sculptor Benjamin Waterhouse Hawkins (1807-1894) is best remembered today for his sculptures of ancient reptiles at the Crystal Palace in Sydenham, but in his day, he was known as an active and talented lecturer on natural history. He delivered his lectures mostly small to medium towns and cities in Great Britain and the United States, where he lived from 1868 through 1878 (Fig. 5).

Fig. 5. Benjamin Waterhouse Hawkins in 1862. Wellcome Collection.

The main attraction of Hawkins's lectures, most of which were on ancient extinct creatures, were hand-drawn chalk illustrations on specially treated canvas screens, which were erased as soon as the lecture was over. These drawings were large enough to require a set of rolling library steps to reach the top. The hand-drawn illustrations were accompanied by posters and wall charts designed by Hawkins and printed in advance. Both types of illustrations sometimes were supplemented by fossils and other specimens housed in local museums and philosophical societies.[16]

Another British visitor who used freehand drawings to illustrate his lectures on natural history was Rev. J. G. Wood (Fig. 6), who lectured widely in towns and small cities and did two tours of the United States in the 1880s. Although he lacked formal training in science, Wood became one of the foremost popularizers of natural history in Britain, publishing dozens of richly illustrated books on zoology, including a three-volume set called *Animate Creation*, and more focused titles such as *Bible Animals*, *Homes Without Hands*, *Common Objects of the Microscope, Common Objects of the Seashore,* and many others, some of which sold tens of thousands of copies in multiple editions.[17]

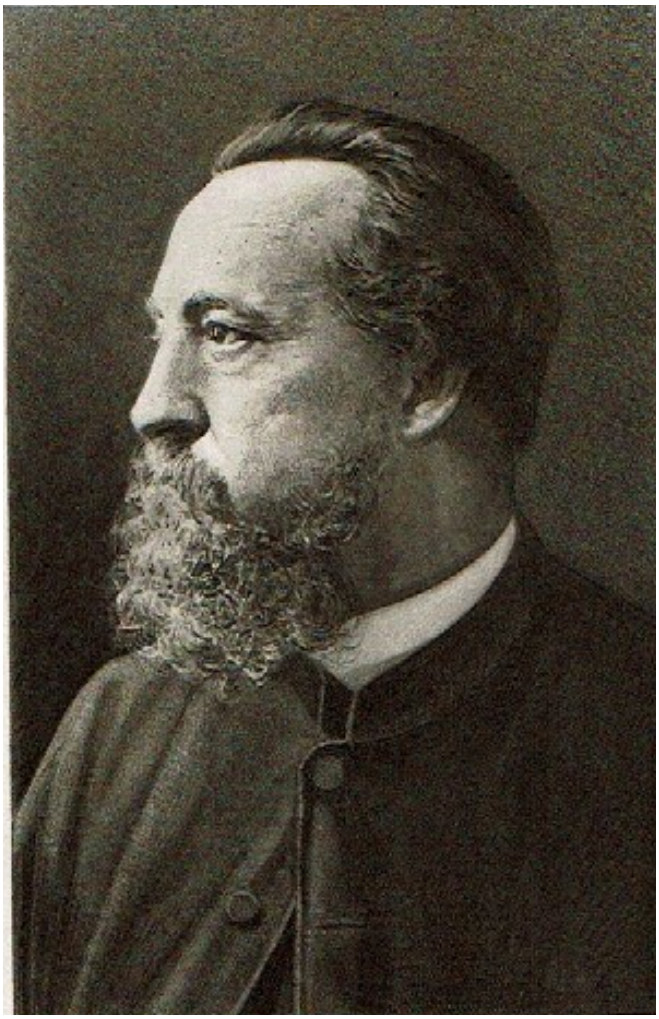


Fig. 6. Rev. J. G. Wood (1827-1889), popular writer and lecturer on natural history, a quintessential parson-naturalist of the Victorian Era. Wells collection

Wood began giving occasional lectures in 1856 and in 1879, began regular lecture tours, including two tours of the United States. Initially he relied on prepared diagrams and specimens to illustrate his lectures, but switched to freehand drawing when he took up lecturing as a career. His first attempts using chalk on a blackboard proved to be too small for a large audience, so he designed his own drawing surface consisting of black-painted canvas mounted in an iron frame. This arrangement was very heavy and rather cumbersome to set up and take down. His final version consisted of a large canvas (11 feet by 5.5 feet) stretched on a wood frame, all of which was supported by a metal framework. Multiple coats of black paint were applied to the canvas, followed by further treatment to render the surface suitable for holding the images. Rather than ordinary chalk, Wood used multi-colored pastels manufactured for him by a dealer in Paris. This arrangement enabled him to produce colorful freehand drawings of everything from butterflies to whales without erasing drawings already on the canvas. In his biography of Wood, his son acknowledged that Mr. Waterhouse Hawkins had been lecturing at the Crystal Palace with freehand drawings on blackened canvas, but naturally insisted that his father's design was far superior.[18]

It may seem odd that Wood would use drawings to illustrate his lectures in an era when magic lanterns were already widely used for lectures, especially as nearly an hour was required to set up the apparatus and a similar amount of time to take it down. One advantage of this approach is that illustrations did not have to be prepared in advanced and carried from one venue to another. Beyond that, Wood believed that illustrating his lectures with colorful freehand drawings added a dramatic touch to his talks, which he called "sketch lectures," and considered them to be the main attraction for his audiences. Indeed, after Oliver Wendell Holmes, inventor of the American style of stereoscope, attended one of Wood's lectures on "Pond and Stream," he wrote:

> I looked as well as listened and saw the stickleback [Fig, 7] and his little aquatic neighbours grow up on the black canvas from a mere outline to perfect creatures, resplendent in their many-coloured uniforms. The lecture had much that was agreeable, but the coloured chalk improvisaton was fascinating to the old and young alike, and was—as it deserved to be—heartily applauded."[19]

Fig. 7. Three-spined sticklebacks on a postage stamp from the Faroe Islands.

Some public lecturers combined different modes of illustration. For example, in 1869, Prof. Adrian John Ebell of New Haven (Fig. 8) gave a lecture on corals, mollusks, snails, and cuttlefish at the Cooper Institute in New York. This was one of several talks in a course on zoology. "The lecture was illustrated throughout with extemporized drawings on the blackboard and afterwards by more elaborate representations by means of the magic lantern."[20] The problem with this arrangement is that blackboard drawings require a well lit room, whereas the magic lantern requires a darkened room, so it is not surprising that lantern slides were shown at the end of the talk.

Fig. 8. Adrian John Ebell (1840-1877), who lectured on zoology in 1869 using both blackboard drawings and magic lantern slides. Wikipedia.

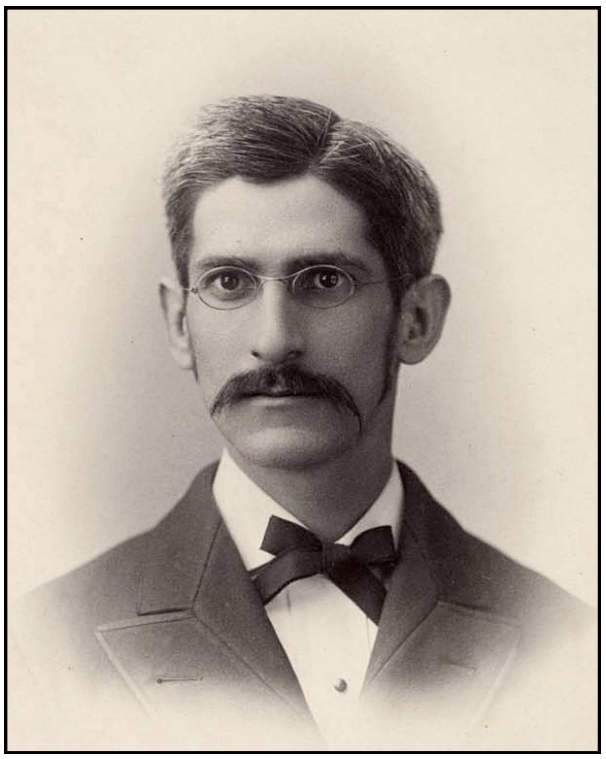


Fig. 9. Prof. E. A. Birge of the University of Wisconsin, who illustrated his lectures on bacteriology with a combination of blackboard drawings and stereopticon views in 1892. Wikipedia.

In 1892, Prof. E. A. Birge (Fig. 9) of the University of Wisconsin presented a course of six University Extension lectures on bacteriology in the Assembly Room of the State Capitol building in Madison Wisconsin. His lectures were illustrated with blackboard drawings and stereopticon views (Fig. 10).[21] This combination of blackboard illustrations and projected slides became a standard method for teaching science from high school to university classrooms for the next century, with 35 mm color slides eventually replacing glass lantern slides. In public lectures, the use of blackboards faded away in the late 19th century as lantern slides became the dominant mode of illustration .

Fig. 10. Lantern slide from the early 1900s, produced by the City of New York Department of Health, showing tetanus bacteria. National Museum of American History.

Biology Lectures in the Era of the Magic Lantern

It is difficult to determine exactly how many lectures were illustrated with magic lantern slides, because newspaper accounts often do not specify the type of illustrations used or do not mention illustrations at all. A search of several newspaper databases located 41 public lectures on biology-related topics from 1869 to 1898. Only 19 of these mentioned magic lantern or stereopticon slides, four more had language that suggested the use of projected images ("some fine illustrations were thrown upon the screen"), eight used the term "illustrated lecture," and 10 said nothing at all, but covered topics such as "flowers" or "animal coloration" that almost certainly would have been illustrated with colored lantern slides. A few others were given by lecturers known from other sources to have used lantern slides. Probably these numbers are huge underestimates because only a few large databases were searched, and some accounts mention a single lecture from what actually was a course of several lectures.

Other lectures, even those given by prominent naturalists, simply did not appear in the newspaper survey for one reason or another. For example, Alfred Russel Wallace (Fig. 11), co-discoverer of Darwin's theory of natural selection, toured the United States in 1886, yet his name did not turn up in my search. Perhaps this was due to some defect in the search or gaps in the newspaper databases. It also may reflect the rather meager coverage of Wallace's lecture tour by the American press compared to the attention paid to other foreign visitors.[22]

Fig. 11. Alfred Russel Wallace in the 1880s.

Wallace did not use lantern slides for all of his lectures, but did use them to illustrate topics such as animal coloration, presumably with hand-colored slides. He showed a number of stereopticon views in his natural history lectures at the prestigious Lowell Institute in November 1886, a development he referred to in a letter to his wife as the beginning of his "lantern lectures."[23] He did not travel with his own stereopticon, but obtained projectors and projectionists at lecture venues. Sometimes this meant lecturing with a poor quality magic lantern, as happened in the small city of Salina, Kansas (population about 6000), where barely 100 people showed up for his lectures.[24]

Photographing Life

The rapid spread of photography in the second half of the 19th century had a profound effect on the ways in which scientists collected, interpreted, and transmitted scientific evidence.[25] In the field of natural history, a photograph provided an accurate record of field observations that could be reproduced hundreds of times at low cost (Fig . 12). The capacity to reproduce the same image over and over again enabled the development of a booming lantern slide industry, especially after the invention of dry plate photography in 1871. Lantern slides produced from dry plate glass negatives were much cheaper and much easier to produce than the slides made using the older wet plate process by the Langenheim brothers in the 1850s and 1860s. It is not surprising, then, that little record exists of serious public lectures on biology and natural history using lantern slides as illustrations until after 1870.

Fig. 12. Lantern slide of bird eggs in a nest (date and photographer unknown). This photograph provides a more realistic image that a painted slide. Wells collection

Illuminating Life

Another necessary step in the development of public lectures to large audiences was the use of brighter illumination than that produced by ordinary magic lanterns. The Marcy sciopticon (Fig. 8), introduced in Philadelphia in the 1860s, had a special double-wick design, provided a brighter light than a single wick with kerosene or lamp oil, and was capable of producing a clear image 10 feet in diameter. The design spread to Britain and various countries in Europe. It proved to be an ideal lantern for use in parlors, churches, and classrooms with audiences up to a few dozen people, but was not well suited for large lecture halls and auditoriums with audiences up to several hundred people.[26]

Fig.8. The Marcy sciopticon, invented by L. J. Marcy in the 1860s and widely imitated by other manufacturers, was touted as the ideal lantern for schools and churches, but was not suitable for large audiences. Wells collection.

In 1860, a large limelight lantern imported from England by chemist John Fallon was exhibited in Philadelphia and given a new name, The Stereopticon, which soon caught on as a name for high quality lanterns illuminated by limelight, especially those used to show photographic slides.[27] In Philadelphia, several exhibitors soon used the name for their own lanterns, either imported or American made. Most of these early exhibitions were lectures on travel, art, or the Civil War.[28] After 1870, the term "stereopticon" increasingly referred to lanterns used in public lectures to large audiences[29]

The use of limelight illumination revolutionized public lecturing by providing the brightest illumination available at the time. Along with other technical improvements in lantern design, limelight allowed images to be projected across the full length of an auditorium. Limelight actually had been available in the United States since the 1820s, when oxy-hydrogen microscopes were widely exhibited across the country.[30] The popular scientific lecturer and showman, Dionysius Lardner, used limelight lanterns in the 1840s.[31] However, there is little evidence of serious public lectures on natural history and biology using limelight lanterns before 1870. After that, manufacturers made continuous improvements in lantern technology and illumination. Limelight stereopticons became the preferred instruments for illustrating lectures on science.[32] In my somewhat incomplete newspaper survey of biology and natural history lectures, the first use of the term "magic lantern" to describe the projection apparatus was in 1869 (see note 20) and the last was in 1879, when Albert G. Wetherby, Professor of Natural History at the University of Cincinnati, lectured on "The Nutritive System of Animals" in the rooms of the Cincinnati Society of Natural History.[33]

Who Lectured on Biology and What Did They Talk About?

One pattern revealed by the newspaper survey is that many lecturers on non-medical biological topics had some professional connection to a school, college, or museum and more often than not, were referred to as "Professor," although not all had Ph.D. degrees. These lecturers tended to stay close to home, either delivering public lectures at their home institutions or local scientific societies and other nearby venues. Some of the better known lecturers were invited to speak in other cities and even other states. Some presented courses of five or six lectures at various institutions, but there is little evidence of biologists undertaking national lecture tours like those of George Cromwell or John L. Stoddard.[34]

The subject matter of these lectures can be largely divided into those on Botany and Zoology, with a few on other biology-related topics such as Microbiology, Evolution, or Paleontology. Lectures on Botany were far less common than those on Zoology, with the first announcements of Botany lectures appearing in 1895. Most botanical lectures could be characterized as descriptive natural history. For example, in January 1895, John Clayton Gifford (Fig. 9), Special Forestry Agent of New Jersey and the first American to hold a Ph.D. in Forestry, lectured on the geographical distribution of plants. His talk, delivered at the Teacher's College in Riverside Heights, New York (public invited). His lecture was "illustrated with stereopticon pictures of tropical trees and their products."[35]

Fig.9. Dr. John Clayton Gifford, who moved from his native New Jersey to Florida in 1902 and eventually became a Professor of Forestry at the University of Miami.

In February and March 1895, the Field Museum in Chicago, opened a few months earlier in what had been the Art Gallery of the Columbian Exposition in 1893, hosted a series of lectures on natural history. Of the six newspaper announcements that I found, only two were on botany and four on Zoology. None of these announcements specified the type of illustrations shown, but the topics covered almost certainly would have been illustrated with stereopticon slides. Salem H. Peabody (Fig. 10) gave a lecture on "The Story of a Birch Tree." Peabody had taught physics, and engineering at several colleges and had been President of the University of Illinois. He also held various administrative positions with several World's Fairs. Earlier in his career, he published a series of juvenile books called *Cecil's Books of Natural History*, which may explain his interest in birch trees. The books were named for his son, Cecil Peabody, who became a physicist at MIT.[36]

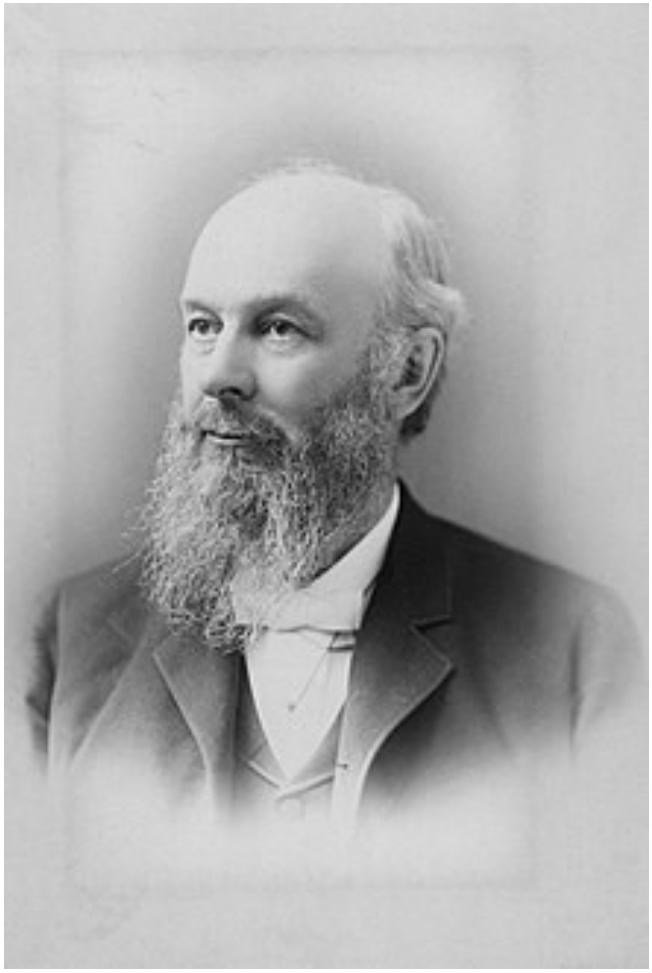


Fig. 10. Selim H. Peabody (1829-1903), physicist, engineer, college administrator, and amateur naturalist, who lectured on birch trees in 1895.

An example of a professional botanist who gave public lectures on botany in the 1890s is Thomas Huston McBride (Fig. 11), Professor of Natural History at the State University of Iowa. In March 1895, he gave several lectures open to the public in Omaha, Nebraska, including talks on ferns (Fig. 12) and flowering plants, "illustrated by use of the stereopticon."[37]

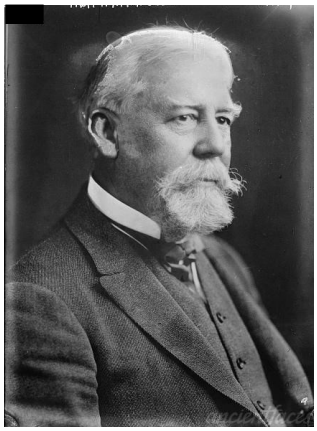


Fig. 11. Prof. Thomas Huston McBride lectured on ferns and flowering plants with the stereopticon. Library of Congress.

Fig. 12. Lantern slide of a group of ferns. Wells collection.

In June 1895, Henry Bird of Newark, New Jersey, gave an illustrated lecture on "The evolution of flowers" to the New Jersey Club of Scientific Review.[37] Bird made his living as a horticulturist and floriculturist. A brief biographical sketch published in 1897 connected his practical work raising plants with more theoretical topics in biology:

> Mr. Bird's business as a floriculturist has kept him in close communication with the beauty and grandeur of Nature—in fact, for the last twenty years he has become a thorough student of science, especially the doctrine of evolution as taught by Darwin, Huxley, Spencer and others. He often gives lectures on questions related to floriculture.[38]

Bird seems to have given illustrated lectures mostly to local clubs and societies. The sketch quotes a description of one of his lectures from a local newspaper:

> Henry Bird, of Newark, delivered an interesting lecture on "The Evolution of a Flower," in Decker's Hall, Orange, last night, under the auspices of the New Jersey Floricultural Society. About 150 persons, including prominent society people in the Oranges, were present, and the hall and stage were decorated with a fine collection of orchids, carnations and foliage plants.[39]

Fig. 12. Henry Bird of Newark, New Jersey, floriculturist and free thinker who delivered illustrated lectures on flowers. *The Free Thought Magazine*, vol. XV (June 1897).

Joseph T. Rothrock (1839-1922) (Fig. 13) gave an "illustrated lantern lecture" on forestry in January 1896 at the State Normal School in Trenton, New Jersey.[39] At the time, he was the Forestry Commissioner of Pennsylvania, but he had followed a circuitous career path to get to that point. He became interested in botany and natural history while walking through the Pennsylvania woods as a child. He attended Harvard and studied botany with Asa Gray, receiving a Bachelor of Science in Botany. He then served in a cavalry unit in the Civil War. After the war, he received a Doctor of Medicine degree from the University of Pennsylvania in 1867. For a few years, he was a practicing physician, following the early career of Asa Gray, specializing on diseases of the eye and ear. He also taught botany, human anatomy, and physiology at Pennsylvania State University. Further studies in Germany caused him to switch to a career in forest management and became known as the father of Pennsylvania Forestry. Through the Pennsylvania Forestry Association, he made it his mission in life to "incite the interest of people throughout the state on forestry—to preserve, protect and propagate the forest."[1] Presumably his lantern lecture on "The relation of forests to the surface of the country" was part of this effort.[39]

Fig. 13. Joseph T. Rothrock, the father of Pennsylvania Forestry, who used lantern slide lectures to promote the management and preservation of forests.

A better known botanist who gave lectures with lantern slides was Henry H. Rusby (1855-1940) (Fig. 14). Like many other botanists of the period, he studied medicine and received his M.D. degree in 1884 from New York University School of Medicine. He abandoned medicine for botany and participated in several expeditions to South America to collect plants and was one of the founders of the field of Economic Botany. He was Professor of Botany and Materia Medica at the School of Pharmacy at Columbia University. No doubt he was called upon to give many lectures on a variety of topics, including one on "Poison Herbs Among Us," accompanied by stereopticon views.[41]

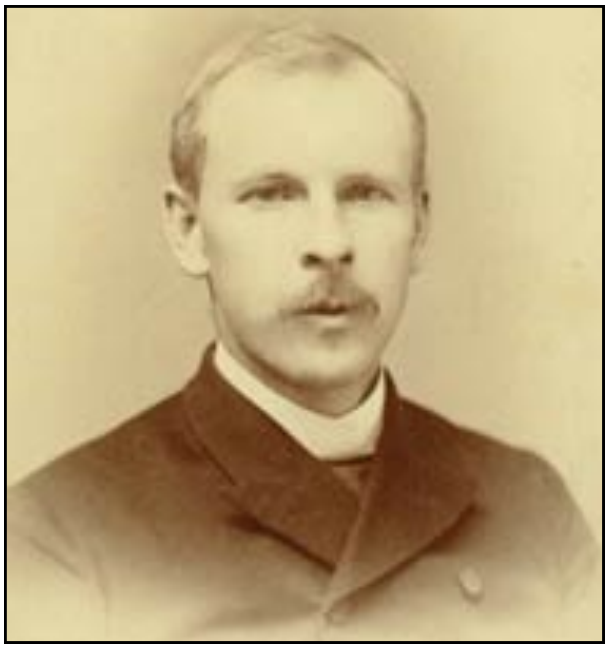


Fig. 14. Henry H. Rusby, who lectured on poisonous plants with the stereopticon in 1895.

Another medical man who lectured on botany was Dr. Joseph H. Hunt, M.D., a prominent Brooklyn physician who was very active in several medical societies. He also was a long-time member of the Botany Department at the Brooklyn Institute and served as the Curator of its herbarium. In October 1898, he lectured at the Institute's Polytechnic Hall on The Cactus Family, "illustrated by lantern photographs" (Fig. 15).[42]

Fig. 15. Hand-colored lantern slide of a brittle prickly pear cactus. Photo by Ned. L. Huff (1936). University of Minnesota Library.

Fig. 16. William Hamilton Gibson in his artist's studio in Washington, Connecticut. From: John Coleman Adams (1901). *William Hamilton Gibson: Artist—Naturalist—Author*. New York: G. P. Putnam's Sons.

In April 1896, William Hamilton Gibson (1850-1896) (Fig. 16) delivered an illustrated lecture on "The Mysteries of the Flowers" at Wellesley College in Wellesley, Massachusetts.[43] It may have been one of his last, because he died only three months later, reportedly of overwork. Gibson had studied engineering at Brooklyn Polytechnic Institute, but dropped out after the death of his father. He worked in the insurance industry, but soon took up the study of natural history, and became a popular author, illustrator, photographer, and lecturer in that field.[44]

In November 1896, Prof. W. K. Kerstetter presented in Cleveland, Ohio a lecture on "Wonders of the vegetable and animal kingdoms," illustrated by a projecting microscope.[45] Not much is known about Kerstetter, but he seems to have been involved in map making and was a Fellow of the American Geographical Society.[46] Another 1896 announcement for a lecture on "Science and Travel" at a girls' college in Pittsburgh described Kerstetter as "the great biologist and traveler." The lecture included a strange mixture of subjects, including botany:

> [Kerstetter] quickly threw upon the canvas which had been placed at the back of the platform, illustrations of the different parts of the magnificent mechanism of the body of man. The intricacies of the stomach were shown and the veins in the body, a drop of blood, the beauty of the formation of the kidney, all of which was colored in natural colors and palpitating as in healthy life. One of the most striking features was a portion of the most delicate tissues of the brain, where "the soul goes in and out." Bits of animal life were then shown, the mosquito (Fig. 17) for one thing, from the stage when the first breath of life began to stir until it became a full-fledged summer tormentor. The insect moved about over the canvas as if caged, only it was magnified 10,000 times. In the vegetable life exhibited and interestingly discoursed upon a pond lily leaf (Fig. 18) was shown as the magnifying glass reveals its inner beauty, a delicate blue veiling tissue, that appears that it might be the brain of the plant. It reminded the untutored of the picture of the human brain exhibited a few minutes before. . . . The dandelion seed flying about for a restingplace, was revealed on the canvas in its journey, and the little wings with which other familiar plants, which grow by the wayside, are provided when the seedtime comes. Later the professor exhibited some beautiful works of art, copies of famous paintings and pieces of statuary, and dwelt in such pleasing fashion on their history and beauty, that when the last word had been spoken and the last picture slipped away, the young listeners had so absorbed the spirit of art and poetry that perfect stillness reigned and nobody rose to leave the seats.[47]

Fig. 17. Lantern slide of a mosquito. www.microscopist.net

Fig. 18. Water lilies in Prospect Park, Brooklyn (1898). Brooklyn Museum.

in the 1890s, large educational institutions such as colleges and universities, institutes, and museums, became increasingly involved in the presentation of public illustrated lectures, by offering courses of lectures or by accumulating collections of slides that could be lent to or rented to speakers. For example, in 1898-1899, the Department of Botany at the Brooklyn Institute of Arts and Sciences (Fig. 19) offered a course of six illustrated lectures. The first

Fig. 19. The Brooklyn Institute of Arts and Sciences around 1905-1915. The Institute became a center for illustrated lectures in biology. Library of Congress

was the previously mentioned lecture by Joseph Hunt on "The Cactus Family" illustrated by lantern photographs. In November 1898, the Department of Botany and the Department of Microscopy cosponsored an illustrated lecture on "The Bacteriological Methods of the Laboratories of Europe." The speaker, Prof. Herbert W. Conn (Fig. 20) of Wesleyan University in Connecticut, was not a botanist, but was a pioneering bacteriologist.[48]

Fig. 20. Prof. Herbert W. Conn (1879-1917) of Wesleyan University.

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The January 1899 lecture was given by Smith Ely Jelliffe (Fig. 21) on "The Movements of Plants," illustrated by lantern photographs. Jelliffe intended to specialize in botany and pharmacology, but eventually switched to neurology and psychiatry. He received his undergraduate degree in 1886 from Brooklyn Polytechnic Institute, an M.D. from Columbia University in 1889, and a Ph.D. from Columbia with a dissertation on *The Flora of Long Island*.[49]

Fig. 21. Smith Ely Jelliffe (1866-1945), a New Yorker trained in medicine, neurology, and botany, who gave a lantern slide lecture to the Botany Department of the Brooklyn Institute in 1899.

Fig.22. Cornelius Van Brunt (1827-1902), a direct descendant of a Dutch settler who arrived on Long Island in 1653. Van Brunt did not have a college degree, but became a famous flower photographer rather late in life (Fig. 22).

One of the more notable individuals who participated in the Brooklyn Institute lecture series was Cornelius Van Brunt (Fig. 22). In fact, he gave two botany lectures, the first on Feb. 16, 1899, with 125 colored lantern slides of "Parks and Flowers of Greater New York." The second, on April 20, was on "The Flowers and Glaciers of the Higher Selkirk Mountains" [British Columbia]. Despite a career mostly devoted to business, he became a star of the botanical lecture circuit, mostly speaking to botanical gardens, botanical clubs, and institutes. The secret of his success was his wife, who served as his colorist and became famous in her own right for the beauty of her work. The first lecture using Mrs. Van Blunt's colored lantern slides was given by Cornelius at the New York Camera Club in 1893. Her work as a colorist continued until his death in 1902.[50]

Fig. 23. Elizabeth Gertrude Britton (1858-1934), a distinguished botanist who specialized on mosses and ferns and frequently gave public lectures on these and other plants illustrated with lantern slides.

The only woman to lecture in the 1898-1899 Brooklyn Institute series was Elizabeth Gertrude Britton (Fig. 23), who gave a lecture on "Our Eastern Ferns as They Grow," illustrated by lantern photographs and by mounted specimens of ferns. After graduating from Normal School (later Hunter College), she took a position as a teacher at the same school. She developed a keen interest in Botany, especially mosses and ferns. In 1885, she married another botanist, Nathaniel Britton, and gave up her teaching position to take an unpaid position as curator of the moss collection at Columbia, eventually becoming one of the country's most celebrated bryologists (a student of mosses), publishing 107 papers on the subject. She was a frequent lantern slide lecturer and spent much of her career fundraising for the New York Botanical Garden, which she helped to found. As was typical for women of her era, she received little or no financial compensation for her scientific research or her public service.[51]

Mrs. Britton was clearly an outlier among lantern slide lecturers in biology. My somewhat incomplete newspaper survey of lecturers on zoological topics did not include any female lecturers, no doubt due to the limited educational opportunities for women. Although some male lecturers had degrees in subjects outside of zoology, especially medicine, many others took advantage of new educational opportunities to get advanced training and even Ph.D.s in zoology. Others lectured on topics far outside their areas of advanced training. For example, Dr. Richard Upton Piper (1816-1897), an American surgeon who studied botany and medicine, is perhaps best known for his spectacularly illustrated self-published *Trees of America* (1855), which now sells for several thousand dollars on the rare book market (Fig. 24). Yet in 1876, he used a lecture at the YMCA in Chicago on "Insect Anatomy" to refute Darwin's Theory of Evolution.[52]

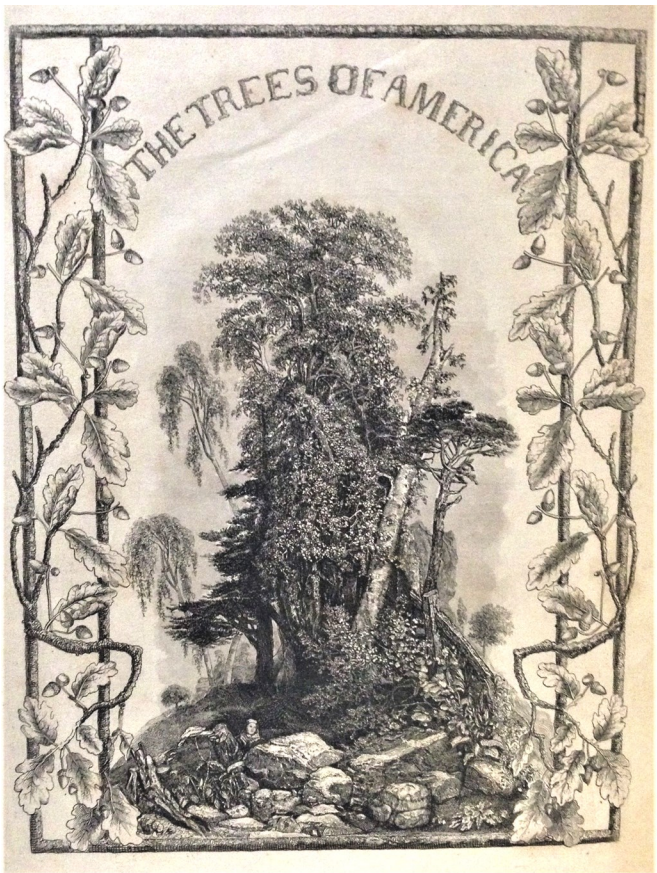

Fig. 24. Trees of America (1855) by Richard Upton Piper, with spectacular illustrations by the author.

Like botanical lectures, most illustrated zoological lectures focused on single group of animals, and a fairly narrow range of species—my newspaper survey turned up lectures on insects, fishes, marine organisms, and mammals, but little or nothing on non-insect invertebrates, amphibians, reptiles, or birds. By the 1880s and 1890s, venues for illustrated zoological lectures gradually moved away from general public halls such as churches, mechanics' halls and YMCA halls to educational institutions such as colleges, universities, institutes, and natural history museums, some of which supplied places for these events and lantern equipment, slides, and speakers.

In 1889, Francis Hobart Herrick (Fig. 25) delivered an illustrated lectures on "Life on a Coral Reef" at Calvary Chapel in Cleveland Ohio. Herrick was Professor of Biology at Adelbert College of Case Western Researve University with broad interests in natural history. He was especially interested in birds and wrote the first scholarly biography of John James Audubon, but is best known for his monograph on the *The American Lobster* (1895), illustrated with 100 of his own drawings. He also was a pioneer in wildlife photography and took some of the first photographs of bald eagles in the field.[53]

Fig. 25. Francis Hobart Herrick (1858-1940), American biology professor, naturalist, illustrator, and photographer. http://www.ohrstromblog.com/spsarchives/archives/4628

Leland O. Howard (Fig. 26), well known Agriculture Department entomologist who often lectured on insect pest control to various scientific and cultural organizations, ran into some bad luck when he lectured on "Destructive Insects of Shade Trees" at the Art Building in Springfield, Massachusetts in 1897: "It had been the intention to have the lecture illustrated with stereopticon slides, but after delaying the address for nearly half and hour the operator failed to appear."[54]

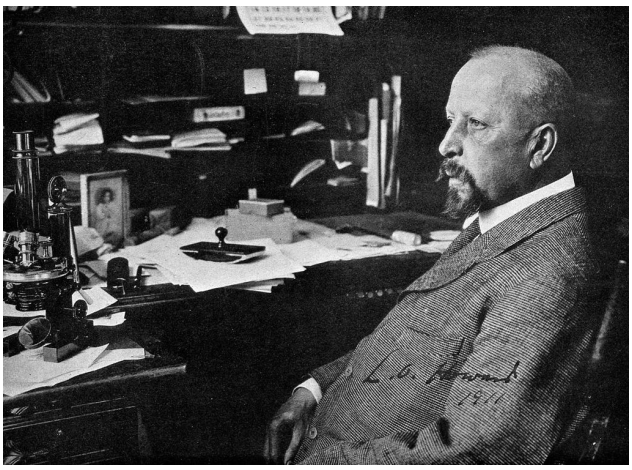

Fig. 26. Leland O. Howard (1857-1950), an Agriculture Department entomologist who frqently lectured on control of harmful insects. Welcome Collection.

One of the more remarkable men to appear on the list of zoological lecturers was Thomas C. Mendenhall (Fig. 27), who in 1895 presented a talk at the Worcester YMCA on The Bering Sea Seals and Seal Fisheries, "illustrated with "some especially fine views, which, by the aid of a powerful stereopticon, will be thrown upon the canvas."[55] At the time, Mendenhall was President of Worcester Polytechnic Institute. By profession, he was a largely self-taught physicist and meteorologist who became involved in coastal survey work in Alaska, which presumably explains his interest in the Bering Sea seal fisheries.[56]

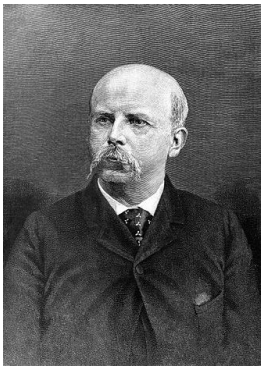

Fig. 27. Thomas C. Mendenhall (1841-1942). He spent three years In Japan, where he gave public lectures on a variety of scientific topoics and continued giving illustrated lectures when he returmed to the United States.

The professional biologist who perhaps contributed most to the growing use of lantern slides in public lectures on natural history was Albert S. Bickmore (Fig 28). He studied chemistry, geology, and mineralogy at Dartmouth College. He then worked in the laboratory of the famous naturalist Louis Agassiz at Harvard. He became one of the founders of the American Museum of Natural History in New York, where he devoted most of his efforts to public education.[57]

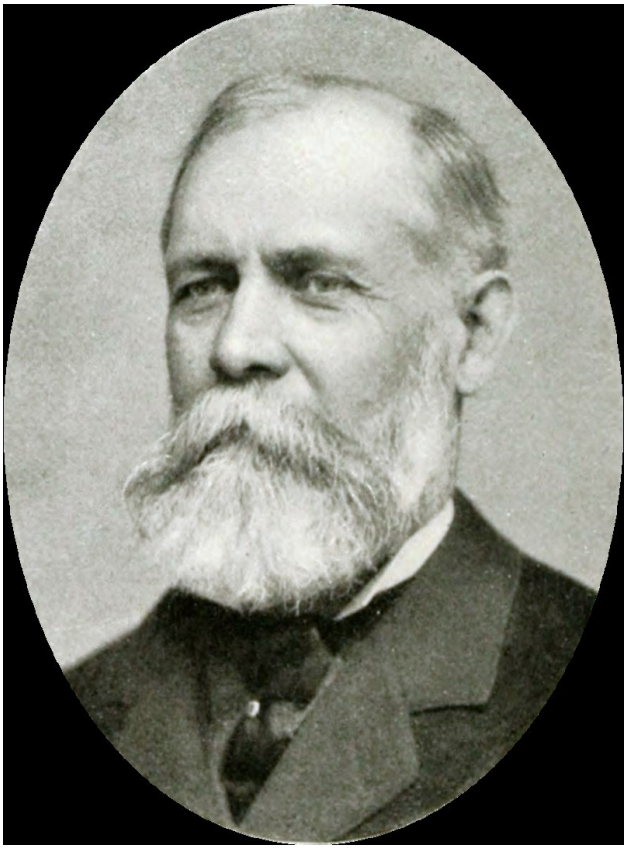

Fig. 28. Albert S. Bickmore (1839-1914), a founder of the American Museum of Natural History and a strong advocate for the use of lantern slides in illustrated lectures.

Bickmore developed a collection of more than 140,000 lantern slides, many of them hand colored, which were used in his own lectures and those of other Museum staff. They also were used for a lending library that distributed slides to schools across New York. Bickmore himself lectured on a wide range of topics, from the races of man to almost every kind of vertebrate animal, both in a long-running lecture series at the museum and in other venues outside of New York.[58] He also became a well known travel lecturer. In 1894, he even presented lantern slides of the Holy Land in a six lecture program on "Studies in the Life of Christ" in which talks by ministers were followed by Bickmore's slides.

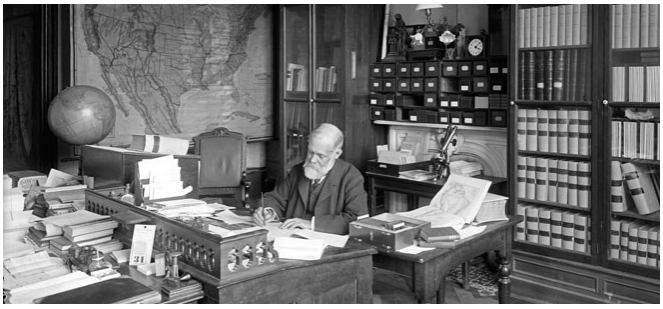

Fig. 29. Albert S. Bickmore preparing a lantern slide lecture in his office. American Museum of Natural History, AMNH 46326.

The *New York Evangelist* described the event and commented on Bickmore's reputation as a lecturer:

> The expositions, by well known city pastors, will be brief—not over half an hour in length; but they will be followed by views on the stereopticon, that will bring all the sacred places into view, with explanations and comments that will make them real to every eye. This no on can doubt when told that they will be by Professor Albert S. Bickmore, who is well known both as a traveler and a lecturer. He has been in every corner of the globe, extending his journeys beyond the southern part of Asia, into the Malayan Achipelago, to Sumatra, Java, Borneo, and New Guinea. And then as to the art of putting things, he has no equal. For years he has given lectures at the Museum of Natural History in Central Park that have drawn thousands, who have flocked to hear him that they might teach others.[59]

Conclusions

Several general conclusions can be drawn from this survey of newspaper announcements from the second half of the 19th Century. First, public illustrated lectures on scientific subjects, including biology and natural history were almost entirely the province of men, although a few women served as unpaid assistants or lantern slide colorists. Second, these men seem to have been inordinately fond of facial hair. More seriously, the venues for such lectures moved from town halls, churches, and YMCA halls to educational institutions such as high schools, colleges, universities, and museums. This paralleled the rise of better educated speakers and audiences, including professional scientists who had advanced training in their fields. Finally, it seems clear that this type of survey captures only a small fraction of the lectures that were delivered. Albert Bickmore was widely known as a lantern slide lecturer who gave hundreds, if not thousands of talks, yet only three or four announcements of his lectures turned up in the survey of newspapers from the 1870s through 1899. Many of these lectures probably were announced to the members of botanical clubs, museum associations, etc., and less frequently in newspapers.

Notes and References

1. On the relatively modest role of science in the lecturing culture of Victorian England, see: Martin Hewitt. 2012. Beyond scientific spectacle: image and words in nineteenth century popular lecturing, pp. 79 -93. In: Joe Kember, John Plunkett, and Jill A. Sullivan, eds, *Popular Exhibitions, Science and Showmanship, 1840-1910* (Pickering and Chatto, London). Much of Hewitt's analysis would apply equally well to the United States. Terry Borton's analyses of the trade literature for lecturers on the American Lyceum and Chautauqua circuits, mostly from very late in the 19th century and the first third of the 20th century, show that lectures on science comprised a tiny fraction of illustrated lectures. Lectures related to biology were a small fraction of that group, with most falling into the category of Nature Study; birds were the popular subjects. See: Terry Borton. 2013. 238 Eminent American "Magic-Lantern" Showmen: The Chautauqua Lecturers. The *Magic Lantern Gazette* 25 (1):3-35. MLGvol 25no 01 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive. Terry Borton. 2015. The Professional Life of "Magic Lantern" Illustrated Lecturers, with Introductions to Most Professionals Performing from the 1890s to the 1920s. *The Magic Lantern Gazette* 27 (1) (Spring 2015):3-27. MLGvol 27no 01 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive. Terry Borton. 2015. The Professional Life of "Magic Lantern" Illustrated Lecturers, with Introductions to Most Professionals Performing from the 1890s to the 1920s. Part 2. *The Magic Lantern Gazette* 27 (2-3):3-37. MLGvol 27no 02 03 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive

On popular lectures on astronomy in the English-speaking world, see: Hsiang-Fu Huang. 2013. Beyond celestial toys: orreries and public astronomical lectures in the eighteenth century. *Taiwanese Journal for Studies of Science, Technology and Medicine*, Number 16: 161-222. Hsiang-Fu Huang. 2018. A shared arena: the private astronomy lecturing trade and its institutional counterpart in Britain, 1817-1865. *Notes and Records, The Royal Society* 72:319-341. Martin Bush. 2019. The astronomical lantern slide set and the Eidouranion in Australia. *Early Popular Visual Culture*, 17:1, 9-33. Martin Bush. 2021. Again with feeling: modes of visual representation in popular astronomy in the mid-nineteenth century. *Notes and Records, Royal Society*. doi:10.1098/rsnr.2021.0040 (published online). Very little has been published on early illustrated astronomy lectures in the United States. A recent comprehensive newspaper survey of public magic lantern lectures, especially in science eduction, is discussed in: Dulce da Rochas Gonçalves. 2023. Public lantern lectures in the Netherlands 1880 -1940: A dataset based on historical newspaper advertisements. *European Journal of Media Studies (NECSUS)* 12:368-385. Public lantern lectures in the Netherlands 1880-1940: A dataset based on historical newspaper advertisements - NECSUS (necsus-ejms.org)

2. Kentwood D. Wells. 2017. Fleas the size of elephants: The wonders of the oxyhydrogen microscope. *The Magic Lantern Gazette* 29 (2/3) (Summer/Fall 2017):3-34. MLGvol 29no 02 03 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive

3. Ronald Rainger, Keith R. Benson, and Jane Maienschein, eds. 1988. *The American Development of Biology* (University of Pennsylvania Press, Philadelphia). Philip J. Pauly. 2000. *Biologists and the Promise of American Life* (Princeton University Press, Princeton NJ), especially Chapter 7 (pp. 171-193): The Development of High School Biology.

4. A. Hunter Dupree. 1959. *Asa Gray* (Harvard University Press, Cambridge MA).

5. Pauly 2000 (see note 3), p. 173.

6. A. F. Bechdolt. 1883. Natural sciences in the public schools. *Journal of the Minnesota Academy of Science 2:259-275.*

7. Adolph Frederick Bechdolt (1846-1938) was born in the Kingdom of Württemberg and moved to Pennsylvania with his family at age 6. At the time he wrote his article on natural sciences in public schools, he was a professor of chemistry at Mankato Normal School—now known as Minnesota State University, Mankato. He later had a varied career, serving as a professor of English language and literature at the University of Washington, superintendent of schools in Eugene, Oregon, and then taught at Whatcom High School in Bellingham, Washington for 19 years, serving successively as head of the school's English, foreign language, and history departments before resigning in 1923. He advocated using German high schools as a model for American science education.

8. Martin Hewitt 2012 (see note 1). Scottish geologist Hugh Miller, a prolific author of popular books on geology, did not use visual aids in his lectures, preferring to let his words paint a picture of ancient landscapes (see: Richard Fallon. 2023. The illustrated natural history lectures of Benjamin Waterhouse Hawkins. *Archives of Natural History* 50:347-369).

9. Jonathan R. Topham. 2022. *Reading the Book of Nature. How Eight Best Sellers Reconnected Christianity and the Sciences on the Eve of the Victorian Age* (University of Chicago Press, Chicago IL).

10. Ralph O'Connor. 2007. *The Earth on Show. Fossils and the Poetics of Popular Science, 1802-1856* (University of Chicago Press, Chicago IL), pp.77-80. The use of large wall charts as the main visual aid in popular natural history lectures seems to have faded out in the late 19th century, but they sometimes were used to supplement other visual aids, including magic lantern slides. Large colorful wall charts became an important teaching tool in public schools, starting in Germany and rapidly spreading to other countries. Commercial publishers of educational wall charts offered a rich selection of charts on natural history subjects (see: Massimiano Bucchi. 1998. Images of science in the classroom: wall charts and science education 1850-1920. *British Journal for the History of Science* 31:161-184. A large selection of German natural history wall charts can be viewed at: Zoological - Vintage Wall Charts and Botanical - Vintage Wall Charts.

11. Erkki Huhtamo. 2013. *Illusions in Motion. Media Archaeology of the Moving Panorama and Related Spectacles* (MIT Press, Cambridge MA).

12. Dupree: *Asa Gray* (see note 4), p. 128. Eliza Susan Quincy (1798-1884) was the eldest daughter of Josiah Quincy III (1772-1864), president of Harvard. She was an accomplished artist who worked mostly with pencil drawings and watercolors (Massachusetts Historical Society: Object of the Month (masshist.org).

13. Leonard G. Wilson. 1998. *Lyell in America. Transatlantic Geology, 1841-1853*. (Johns Hopkins University Press, Baltimore MD), p. 90. Russell Smith (1812-1896) | White Mountain Art & Artists

14. For Agassiz's lecture style in general, see: Christoph Irmscher. 2013. *Louis Agassiz. Creator of American Science.* (Houghton Mifflin, New York), especially pp. 91-94. "He topped his earlier performance. . . " Christoph Irmscher. 2017. Introduction to a new annotated edition of Agassiz's *Introduction to the Study of Natural History*, Springer International Publishing, p. 5. On Agassiz's 1847 lecture illustrated with a large painting, see: "Professor Agassiz," *Portland [Maine] Weekly Advertiser*, March 2, 1847, p. 1. On Agassiz's 1865 lecture introduced by Cooke's stereopticon slides, see: "How Professor Agassiz lectures," *Springfield [MA] Republican*, March 25, 1865, p. 4, and Harriette Knight Smith. 1898. *The History of the Lowell Institute* (Lamson, Wolffe and Company, Boston), pp. 35-36. On Prof. Cooke's vertical lantern, see: Kentwood D. Wells. 2018. Henry Morton: prince of American lecturers on science. *The Magic Lantern Gazette* 30 (3-4):3-21. MLGvol 30no 03 04 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive

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An anecdote published in 1874, soon after Agassiz's death, mentions another encounter with the stereopticon, although it is not clear whether Agassiz was actually using the instrument in his own lecture:

> That evening, when it became sufficiently dark, the powerful stereopticon was produced, and the images of live animals (minute sea-life) were thrown upon the screen. The shapes and antics of the specimens—immensely magnified as they were—were very funny. Wishing to point out some notable feature in the creatures, Prof. Agassiz approached the screen, and in doing so, stepped into the beam of light, when instantly his silhouette was cast upon the broad white surface with a glorious effect never now to be forgotten. It seemed to shadow forth that distant day when future students of nature, looking back, shall see the head of Louis Agassiz standing alone and majestic against an unoccupied background of American Science [*New York Tribune*, January 24, 1874. P. 7].

15. In addition to many biographies, information on Huxley's lecturing style can be found in: Diarmid A. Finnegan. 2021. *The Voice of Science. British Scientists on the Lecture Circuit in Gilded Age America* (University of Pittsburgh Press), especially Chapter 2: Reason's rhetor: the scientific oratory of Thomas Henry Huxley, pp. 64-93. For Huxley's drawing style, see: George R. Bodmer. 1997. The technical illustration of Thomas Henry Huxley, pp. 277-295. In: Alan P. Barr, ed. *Thomas Henry Huxley's Place in Science and Letters* (University of Georgia Press, Athens).

16. Fallon 2023 (see note 8).

17. Bernard Lightman. 2007. *Victorian Popularizers of Science* (University of Chicago Press), especially Chapter 4: The Showmen of Science. Wood, Pepper, and Visual Spectacle, pp. 167-218. It was a beautiful three-volume leather bound set of Wood's *Animate Creation* given to me by an uncle when I was in high school that started me on my road to collecting old natural history books and ultimately books on Darwinism and other topics in the history of science.

18. Rev. Theodore Wood, F. E. S. 1890. *Rev. J.G. Wood. His Life and Work* (Cassell Publishing Company, New York), pp. 127-153.

19. Wood 1890 (see note 18), p. 154.

20. *New York Herald*, January 31, 1869.

21. *Daily Inter Ocean* (Chicago), March 12, 1892, p. 12.

22. Diarmid A. Finnegan. 2021. *The Voice of Science. British Scientists on the Lecture Circuit in Gilded Age America* (University of Pittsburgh Press, Pittsburgh PA), Chapter 4: Alfred Russel Wallace, Anticelebrity, pp. 130-165.

23. Finnegan, p. 145.

24. Finnegan, p. 157.

25. Jennifer Tucker. 2005. *Nature Exposed. Photography as Eyewitness in Victorian Science* (Johns Hopkins University Press, Baltimore MD). This book provides a rich analysis of the interactions between science and photography in 19th century Britain, most of which is applicable to the United States as well.

26. Deborah Jean Warner. 1992. Projection apparatus for science in Antebellum America. *Rittenhouse: Journal of the American Scientific Instrument Society* 6:87-94. Stephen Herbert. 2001. Sciopticon. *Encyclopaedia of the Magic Lantern* (The Magic Lantern Society, London), p. 273.

27. Kentwood D. Wells. 2011. The stereopticon men: On the road with John Fallon's Stereopticon, 1860-1870. *The Magic Lantern Gazette* 23 (3):2-35. MLGvol 23no 03 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive

28. Kentwood D. Wells. 2008. What's in a name? The magic lantern and the stereopticon in American periodicals, 1860-1900. *The Magic Lantern Gazette* 20 (3):3-19. MLGvol 20no 03 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive

29. Kentwood D. Wells. 2019. Stereopticon exhibitions in Philadelphia in the 1860s. *The Magic Lantern Gazette* 31 (2):3-9. MLGvol 31no 02 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive

30. Kentwood D. Wells. 2017. Fleas the size of elephants . . . (see note 2).

31. Kentwood D. Wells. 2017. Dionysius Lardner: Popular Science Showman of the 1840s. *The Magic Lantern Gazette* 29 (1):3-18. MLGvol 29no 01 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive. David McLean. 2018. Robert Grant and his calcium light. *The Magic Lantern Gazette* 30 (1):3-13 MLGvol 30no 01 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive.

32. Debbie D. Griggs. 1992. Projection apparatus for science in late nineteenth century America. *Rittenhouse: Journal of the American Scientific Instrument Society* 7:9-15.

33. *Cincinnati Daily Gazette*, December 8 and 13, 1879. Albert Gallatin Wetherby (1833-1902) was a specialist on snails and local fossils who joined the University of Cincinnati in 1878 as Curator of the University Museum and Professor of Natural History (Wikipedia).

34. Kentwood D. Wells. 2013. George Reed Cromwell (1835-1899): America's Most Famous Forgotten Magic Lantern Showman. *The Magic Lantern Gazette* 25 (4):3-45. MLGvol 25no 04 : Magic Lantern Society of the United States and Canada : Free Download, Borrow, and Streaming : Internet Archive.

35. John Clayton Gifford (1870-1949) (Wikipedia). Henry Troetschel, Jr. 1950. John Clayton Gifford: an appreciation. *Tequesta* no. 10:35-47. Ian Tyrell. 2015. Conservation and Forestry in the American Tropics: John Clayton Gifford in Puerto Rico. Environment and Society Portal, *Arcadia* no. 10. Rachel Carson Center for Environment and Society. https://doi.org/10.5282/rcc/7042.

36. Peabody lecture on birch trees: *Daily Inter Ocean* [Chicago], February 4, 1895, p.8. See also: Selim Peabody - Wikipedia. A professional botanist who also lectured at the Field Museum in March 1895 , was John Merle Coulter (1851-1928), but his lecture topic was "Theories of Evolution," with no specific mention of botany. He received three advanced degrees, including a Ph.D., from Hanover College. Upon graduation, he served as Professor of Natural Sciences at Hanover College. He then moved to Wabash College as Professor of Botany (1879-1891). He served as Professor of Botany and President of Indiana University (1891-1893). He was President of Lake Forest College (1893-1896) and finally Professor and Head of the Botany Department at the University of Chicago (1896-1925). John Merle Coulter - Wikipedia.

38. It took some time to track down the identity of Henry Bird. In addition to being a floriculturist and proponent of Darwin's theory of evolution, Bird was a confirmed Atheist and President of the Newark Liberal League, an assemblage of radicals, free thinkers, atheists, agnostics, immigrants, and feminists. See: "Henry Bird," *The Free Thought Magazine*, vol. XV (1897), pp. 297-299.

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Above: Lantern slide of a giant waterbug of the family Belostomatidae, an inhabitant of aquatic habitats in North America. These insects have an unusual reproductive strategy. Females place fertilize eggs on the backs of males, which carry them until they hatch, providing protection and bathing them with oxygen by moving their bodies up and down in the water. Wells collection.

Front Cover: Hand-colored lantern slide of assorted prehistoric marine reptiles, shown in unlikely poses out of water. These were used to teach geology at Wooster College in Ohio well into the second half of the 19th Century. Courtesy of Wooster Geologists.